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CORPORATE GOVERNANCE AND STRATEGIC RESOURCE
ALLOCATION: THE CASE OF INFORMATION TECHNOLOGY
INVESTMENTS

Lawrence Loh
and
N. Venkatraman

Working Paper No. 3565-93BPS

April 1993

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**Corporate Governance and Strategic Resource Allocation:
The Case of Information Technology Investments**

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Abstract

The impact of corporate governance on strategic decisions is emerging as a key concern in contemporary businesses. In particular, governance mechanisms such as stock ownership structure and takeover defenses have major influences on strategic resource allocation in firms. In this paper, we empirically examined a set of relationships between corporate governance and information technology (IT) investments. Using data from a sample of major U.S. corporations, we established a negative relationship between IT investments and two constructs of corporate governance, namely: (1) stock ownership structure (that includes large or insider shareholders); and (2) presence of takeover defenses. These results respectively provide support for: (1) the 'monitoring hypothesis' of risky investments which purports that stock ownership could align the interests of managers with those of shareholders, and (2) the 'managerial entrenchment hypothesis' of risky investments which posits that takeover defenses allow managers to pursue suboptimal decisions. In addition, consistent with existing empirical evidence, we observed a negative relationship between stock ownership structure and takeover defense adoption.

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INTRODUCTION

The determination of the level of investments in information technology (IT) is becoming a central issue in the formulation and implementation of successful IT strategies amongst firms (Banker, Kauffman, and Mahmood, 1993). In particular, these investments are deemed to be critical concerns of top management in corporate strategy decisions (Jarvenpaa and Ives, 1990) that could potentially affect firm value (Dos Santos, Peffers, and Mauer, 1993). More importantly, corporations are recognizing that having an effective IT infrastructure is a key means to attain strategic advantage within the competitive marketplace (Porter and Millar, 1985).

While the continuing emphasis has been on the impact of IT investments within a generalized multi-industry context (Mahmood and Soon, 1991) or a specific firm-level context (Banker, Kauffman, and Morey, 1990), there is a lack of systematic research on the range of determinants underlying such capital investments. Since IT has transcended the traditional functional domain to become more pervasive within and across corporations (Cash and Konsynski, 1985), there is a need to integrate both IT and strategy research in order that a fuller understanding of the motivation for IT investments can be attained.

The established view is that strategic investments, in general, are risky, particularly in domains such as research and development (Baysinger, Kosnik, and Turk, 1991), diversification (Amihud and Lev, 1981), and acquisitions and divestitures (Agrawal and Mandelker, 1987). Our study extends this tradition by arguing that IT investments are also risky corporate decisions. Such a risk-based perspective has recently been surfacing within information systems (IS) research (Clemons, 1991; Clemons and Weber, 1990). Along such a perspective, we delineate a conceptual basis for IT investments using arguments from the theories of corporate governance.

This paper draws from both IS and strategy research by constructing an exploratory conceptual model of IT investments that is based on a corporate governance perspective. It builds upon extant strategic management research that is traditionally concerned with the relationship between corporate governance and allocation of strategic resources (Hill and Snell, 1989). We focus on two constructs -- stock ownership structure and takeover defense adoption -- and examine their specific relationships with the level of IT investments in firms. Given alternative and unresolved perspectives within the theories of corporate governance, we develop competing hypotheses to postulate these relationships within an exploratory conceptual model.

We argue that structure of stock ownership that includes large or insider shareholders can influence the level of IT investments in two directions. One, the ownership structure can align the interests of the managers with those of the shareholders when the actions and choices of these managers are being monitored, thus increasing the level of IT investments (*the monitoring hypothesis*). Two, conservatism in IT investments may arise when certain stockholders (e.g., larger shareholders or inside shareholders), who may not be diversified in their portfolio holdings or who may prefer projects with short-term gains, exhibit risk aversion toward long-term investments (*the conservatism hypothesis*).

Similarly, the adoption of takeover defenses can affect the level of IT investments in two ways. One, a takeover defense, as a governance mechanism, protects the management from the disciplinary effects of the market for corporate control; hence, managers are in a position to pursue self-serving strategies, which then implies a potentially negative impact on the level of IT investments (*the managerial entrenchment hypothesis*). Two, the adoption of takeover defenses can enhance the bargaining strength of the firm vis-a-vis potential acquirers, thus increasing the wealth of the current stockholders and leading to a positive influence

on the level of IT investments (*the stockholder interests hypothesis*). In line with the ability of stockholders to influence takeover defense adoption and existing evidence on the adverse consequence of takeover defenses on shareholder wealth, we also hypothesize that there is a negative relationship between the two constructs of corporate governance.

Our study is potentially important for IS research in several ways. First, it contributes a new basis for the determination of IT investment levels in corporations. Hitherto, the emphasis in the field has been on economics-based analyses within the context of a competitive environment (Barua, Kriebel, and Mukhopadhyay, 1991) and risk- or options-based analyses within a capital budgeting framework (Clemons, 1991; Kambil, Henderson, and Mohsenzadeh, 1993). Our approach departs from this normative tradition by explicitly delineating a managerial control-oriented rationale that describes the relationships between corporate governance and IT investments.

Second, our paper differentiates itself from existing empirical studies that deal with the consequences of IT investments (see Brynjolfsson, 1992 for a review). In particular, we build a theory-based model of IT investments and employ a linear structural relations (LISREL) methodology to examine the governance determinants of these investments. Since this is a first attempt to analyze IT investments from such an 'antecedent' perspective, the results obtained could enrich management research, especially within the IS field.

Third, and perhaps most importantly, our study reiterates the paramount importance of recognizing the intricate and inseparable interactions of information systems and technologies with the accompanying processes of managing, controlling, and organizing (Boland and O'Leary, 1991). We propose that corporate governance mechanisms -- stock ownership structure and takeover defense adoption -- could be vital influencing forces in the way managers make their

decisions to invest in IT on behalf of the shareholders. While these arguments have constituted major concerns of organization researchers, we believe that the IS profession can benefit from an appropriate transfer of knowledge across disciplinary boundaries.

THE RESEARCH MODEL

A Corporate Governance Perspective

As a management concern, corporate governance has increasingly been receiving attention amongst firms (Venkatraman, Loh, and Koh, 1993), and has been examined within the research framework of organizational economics (Hesterly, Liebeskind, and Zenger, 1990). Within such a tradition, agency theory (Jensen and Meckling, 1976) has been advanced as a key theoretical anchor in organizational economics (Barney and Ouchi, 1986). This is based on the notion of a relationship defined by Jensen and Meckling (1976: 308) as “a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf that involves delegating some decision making authority to the agent.” The principal-agent approach is applicable to many contexts of delegated decision-makings, such as in systems development (Banker and Kemerer, 1992). Within the context of our study, this theory has been applied to the assignment of authority from the shareholders (i.e., the principals) to the top management (i.e., the agents).

The fundamental problem of an agency relationship is the nonalignment of goals between the two parties constituting the exchange. The agent, having the locus of control, tends to make decisions maximizing his or her own welfare which may not necessarily coincide with an increase in the principal’s utility. To ensure goal congruence, the principal can engage in costly, albeit imperfect, monitoring mechanisms, such as independent audits. Mitigating mechanisms and bonding

schemes such as voluntary disclosures by the managers to shareholders can also alleviate the agency problem.

A basic dilemma in a principal-agent relationship is the difference in risk preferences of the contracting parties. The adoption of risk is a crucial decision undertaken by the top management. Under goal incongruence, managers may be excessively risk averse and may underinvest in risky projects (Fama and Jensen, 1983). This is especially pertinent when such managers have invested a large proportion of their (human) capital by virtue of being employed in the firm. It has been established that such employment risk could be a critical determinant of managerial investment choices (Demsetz and Lehn, 1985). This absence of personal risk diversification is, in fact, intensified by labor market imperfections (e.g., immobility of executives and lack of job information) that induce managers to pursue 'safe' strategies.

Information Technology Investments

We consider IT investments as a discretionary strategic decision delegated to the top management by the shareholders. The choice of the level of IT investments, like other capital investments of the firm, involves a strategic decision under risk (Clemons, 1991). Clemons and Weber (1990) provided a framework for conceptualizing the riskiness of IT investments, and proposed two broad categories: downside risks (including replicability and competitor response, misapplication of financial models, industry restructuring and environment hazard, long lead times, and organizational barriers) and upside opportunities (including divisibility and expandability, marketing in-house systems, timing value, and flexibility and option value). They suggested a decomposition of risks into separate components: technical risk, project risk, functionality risk, internal political risk, external political risk, and systemic risk.

Within this context, an agency problem arises when managers underinvest in risky IT. Implicit within the conflict of interest in IT investments is a contention that such investments could be positively related to corporate performance. Although the research evidence linking IT investments and corporate performance is fraught with problems of theory and measurement (Brynjolfsson, 1992), the evidence of positive relationship has been forthcoming (see for instance, Banker, Kauffman, and Morey, 1990; Bender, 1986; Harris and Katz, 1991). More fundamentally, this relationship is in line with the paradigm of 'high risk-high returns' that is central to equilibrium models of investments, such as the capital asset pricing model (Sharpe, 1964).

Stockholder Ownership Structure and IT Investments

The monitoring hypothesis. The conflict of interests pervading a shareholder-manager relationship can be affected by the ownership structure of the firm. In particular, the agency problem arising from the delegation of firm decisions is mitigated by concentrated ownership (Demsetz and Lehn, 1985) as well as inside or managerial stock ownership (Jensen and Meckling, 1976). Large shareholders with significant stakes in the firm have stronger incentives to ensure the decisions made by the top management are not self-serving actions that merely appropriate wealth from the equity holders (Shleifer and Vishny, 1986). Thus, a concentrated ownership structure facilitates a behavior-based monitoring from the capital market (Eisenhardt, 1989). In another vein, equity ownership by the top management ties the payoffs or welfare of the managers to the performances of the firm as reflected by the stock market (Lambert and Larcker, 1985). Managers with incentive payments connected directly to the value of the firm are subject to an outcome-based monitoring of the capital market (Eisenhardt, 1989). Applying the monitoring role of the equity capital market to the IT investments context, we hypothesize that:

Hypothesis 1(a): Stock ownership structure that includes large shareholders or inside shareholders is *positively* related to IT investments.

The conservatism hypothesis. Stockholder conservatism in corporate risk-taking may be the outcome when certain stockholders (e.g., large shareholders or inside shareholders) are not diversified in terms of their portfolio holdings (Fama and Jensen, 1983). Levy and Sarnet (1984) discovered that even investors of mutual funds (which are supposedly diversified) were averse to the variance of the returns. Similarly, MacCrimmon and Wehrung (1986: 122) observed that "executives are more risk-averse when their own money was at stake than when their firm's resources were at stake." This implies that managers do distinguish their business and personal roles in the adoption of risks when they have direct interests (e.g., stockholdings) in the uncertain outcomes of the firm. They may then be critically concerned with the exposure when their equity holdings constitute significant proportions of their personal wealth. Further, the capital market may place a high emphasis on firm investments that result in immediate returns, and this may motivate managers to avoid risky projects that can pay off only in the long term. (Baysinger and Hoskisson, 1989). Therefore, we hypothesize:

Hypothesis 1(b): Stock ownership structure that includes large shareholders or inside shareholders is *negatively* related to IT investments.

Takeover Defense Adoption and IT Investments

The market for corporate control is a key mechanism that affects the shareholder-manager relational exchange. It is, however, not a perfect market as firms do implement schemes to influence the likelihood of transfer of corporate control (Walsh and Seward, 1990). In line with Mahoney and Mahoney (1993) and Weston, Chung, and Hoag (1990), we highlight two competing views on the consequences of takeover defenses in the shareholder-manager relationship.

The managerial entrenchment hypothesis. From the perspective of organizational economics, the market for corporate control constitutes one of the

critical institutions of capitalism to align the interests of the managers and those of shareholders (Williamson, 1985). However, takeover defenses may be adopted to shield the incumbent management team from the disciplinary impact of the marketplace, which may lead to myopic decisions by managers (Stein, 1988). By imposing a high level of institutional difficulty toward any transfer of corporate control, such governance features secure the existing managers to the employment and authority positions within the firm (Walsh and Seward, 1990). When the top management is able to avoid the monitoring role of the market for corporate control, there is a tendency for the managers to avoid risks (Amihud and Lev, 1981; Meulbroek, Mitchell, Mulberin, Netter, and Poulsen, 1990). The managerial entrenchment hypothesis has received recent empirical support in studies on the effects of the adoption of antitakeover amendments on stockholder wealth (Mahoney and Mahoney, 1993). We thus hypothesize:

Hypothesis 2(a): The presence of takeover defenses is *negatively* related to IT investments.

The stockholder interests hypothesis. This argues that the adoption of takeover defenses enhances stockholder wealth (Berkovitch and Khanna, 1990). The basic contention is that these defenses provide additional bargaining power to extract the gains from the acquiring company. Thus the interests of existing shareholders are better served, when managers are able to negotiate higher offers from bidding companies. This hypothesis is appropriate when informational asymmetry between the shareholders and managers exists (Bradley, 1980). For instance, a supermajority amendment increases the optimal bid of the acquiring firm when compared to the conventional case of simple majority. In addition, when private synergies exist in a potential acquisition (Bradley, Desai, and Kim, 1983), takeover defenses (e.g., classified board) put the target firm's board of directors in a position to negotiate directly with the bidding firm. This mechanism mitigates the

inefficiency of dispersed shareholders in extracting gains from the acquirer, thus eliminating the often-cited 'free-rider problem' of takeovers (Grossman and Hart, 1980). The ability of takeover defenses in increasing the bid prices is analogous to the extraction of quasi-rents from potential acquirers (Klein, Crawford, and Alchian, 1978). The end result of takeover defense adoption is thus an increase in risky IT investments. We hypothesize:

Hypothesis 2(b): The presence of takeover defenses is *positively* related to IT investments.

Stock Ownership Structure and Takeover Defense Adoption

The markets for equity capital and corporate control are alternative institutions to attain the coalignment of interests between managers and shareholders (Walsh and Seward, 1990; Williamson, 1985). The need for monitoring from the market for corporate control is mitigated by the extent to which existing shareholders are able to influence the corporate decisions of the managers. Singh and Harianto (1989) argued that the adoption of a specific takeover mechanism -- golden parachute -- is reduced by managerial stock as well as concentrated ownership. This is in line with the often-mentioned ability of equity-carrying managers and large shareholders to influence the decisions of the board of directors (Kosnik, 1987). Similarly, it has been demonstrated that ownership structure is negatively related to the adoption of poison pills (Malatesta and Walkling, 1988) and antitakeover charter amendments (Bhagat and Jefferis, 1991).

The generalizability of a negative relationship between stockholder ownership and takeover defense adoption emerges from extant evidence that the adoption of these defenses adversely affects shareholder wealth. Turk (1991) analyzed an exhaustive range of takeover mechanisms and found that competition-reducing mechanisms indeed resulted in negative abnormal gains. Similarly, using a set of different antitakeover mechanisms, Mahoney and Mahoney (1993) observed

negative effects on shareholder wealth in firms that adopted these defenses (see also Jarrell and Poulsen, 1987). Thus, we contend that the adoption of takeover defenses, in reducing the competitiveness within the market for corporate control, are generally contrary to the interests of the shareholders. When shareholders have a greater degree of control of governance choices, they would usually not favor takeover defenses. Therefore, we hypothesize:

Hypothesis 3: Stock ownership structure that includes large shareholders or inside shareholders is *negatively* related to the presence of takeover defenses.

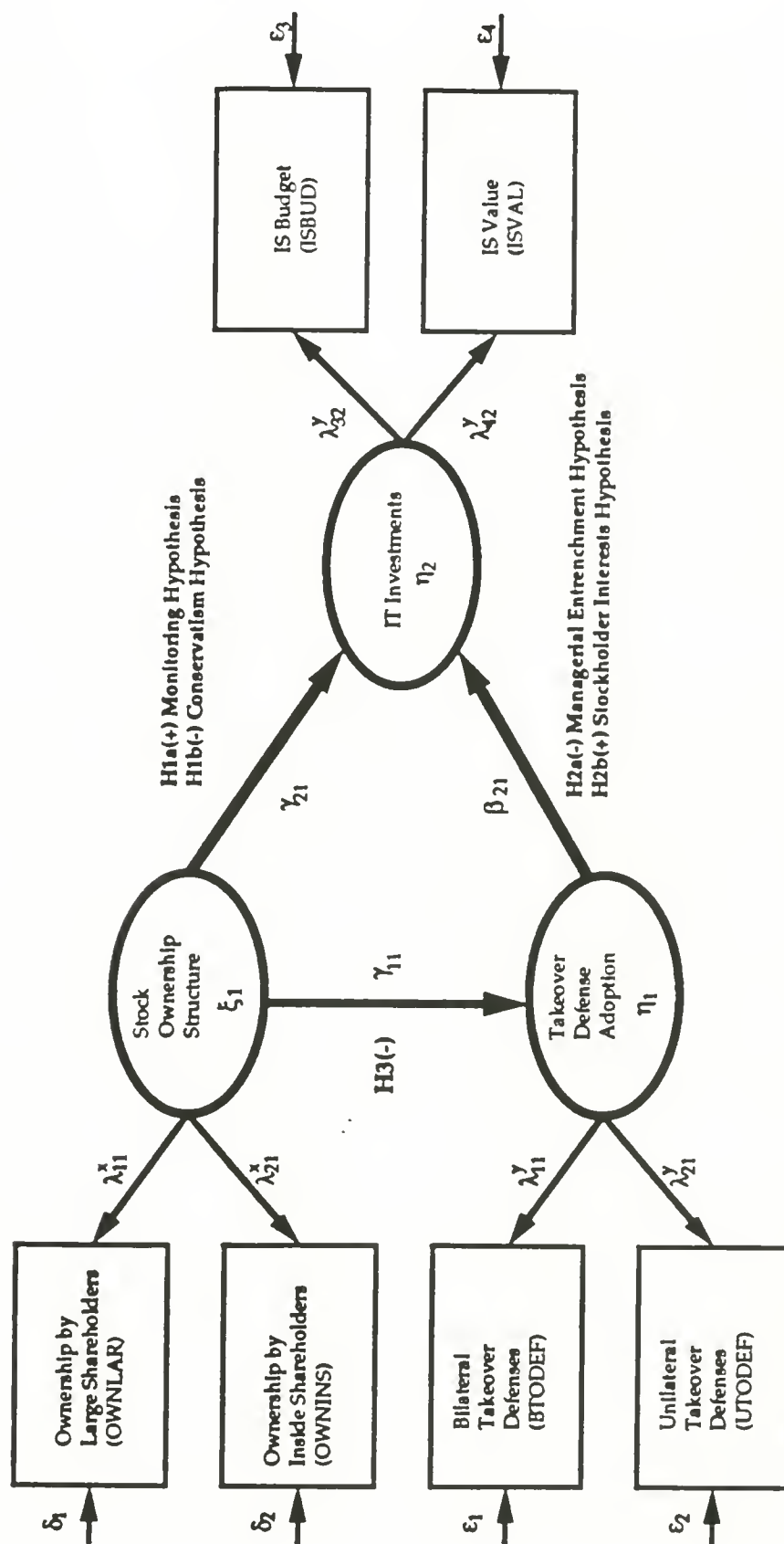
Figure 1 is a schematic representation of the exploratory research model.

METHODS

Data

Data pertaining to the measures of the dependent construct, IT investments, were provided by a leading publisher, *Computerworld* – that maintains a database on information technology investments of major U.S. corporations through surveys conducted by an established market research firm. Our sample consists of leading firms that were willing to supply data pertaining to IT investments. Based on our discussion with the managers of the database, we ascertained that their data collection instruments were adequate for our research purpose. Data on stockholder ownership were extracted from *CD/Corporate*, a *Lotus One Source* CD-ROM database, and data on takeover defense adoption were compiled from Rosenbaum (1989). We used a pooled, cross-sectional sample (n=150) across two years – 1988 and 1989 – but tested for the temporal stability of the results.

FIGURE 1
An Exploratory Governance Model of IT Investments



Operationalization

Stock ownership structure (ξ_1). This construct is represented by two measures. The first is the cumulative stock ownership by shareholders with at least 5% of the total equity (OWNLAR). This measure corresponds to a commonly-used alternative method to operationalize ownership concentration (Baysinger et al., 1991), and captures the incentives and abilities of large shareholders in aligning the interests of the management (Shleifer and Vishny, 1986). The second measure is the stock ownership by inside shareholders (OWNINS) that reflects the extent to which managerial payoffs are tied with corporate performances (Jensen and Meckling, 1976). The inside shareholders refer to the executive officers who have equity holdings in the corporation. Both measures are proportions of the total common equity and are thus censored continuous variables that range from 0 to 1.

Takeover defense adoption (η_1). We considered a broad definition to include those mechanisms that directly affect the possibility of a change in corporate control (e.g., supermajority provisions) as well as those that simply raise the costs of acquisition (e.g., golden parachutes) (Weston et al., 1990). We classified an exhaustive list of 25 available mechanisms into two categories – unilateral takeover defenses (UTODEF) and bilateral takeover defenses (BTODEF).¹ The first category refers to instruments that reduce the likelihood that outside buyers can assume control over the firm. Under the presence of these governance mechanisms, the incumbent managers are protected from the ‘watchdog’ role of the market for corporate control. The second category refers to instruments that are unclear *ex ante* in terms of the likelihood of the transfer of corporate control to external management teams. This ambiguity stems from the *unique* design and motivation underlying the governance mechanism. For instance, such a mechanism may be structured in some instances to diminish competition in the market for corporate control, while in others, it may be initiated to facilitate transfer of control (see

Rosenbaum, 1989 for a coverage of the institutional details underlying each takeover defense).² We used these two measures as ordinal variables formed by counting the number of the appropriate mechanisms in adopted in each category.

IT investments (η_2). We view IT investments broadly to include hardware and software, data communications, and related personnel, consulting and vendor-related service expenditures as embodied within the corporate IS budget (Harris and Katz, 1991; Weill, 1992). The two measures used to operationalize IT investments are (1) the IS budget as a proportion of revenue (ISBUD), which has been adopted frequently in prior research (see Strassmann, 1990), and (2) the estimated market value of the major computer systems installed, normalized by revenue (ISVAL). These two measures are continuous variables.

Analysis

Overview. We tested the hypotheses within a structural equation model (Joreskog and Sorbom, 1989; Pedhazur, 1982) using the maximum likelihood method as implemented in LISREL 7.³ This approach relied on a parsimonious specification of all the parameters for both measurement and structural relationships (see Mahmood and Medewitz, 1989 and Zaheer and Venkatraman, 1992, which provide examples of a LISREL application in IS research). Before estimating the model (Figure 1), we assessed the possibility of confounding effects as discussed below.

Step 1. We ensured that there are no confounding effects due to factors such as: size, performance, financial structure (liquidity and leverage), level of the diversification, and industry sector. For this purpose, we carried out two separate regression analyses with each of the two indicators of IT investments as the dependent variable and the abovementioned control variables as independent variables (see Appendix). We did not find any significant effects. We also ruled out the confounding influences of multicollinearity using several econometric tests.

Step 2. Next, we tested the three hypotheses represented by the structural coefficients – γ_{11} , γ_{21} , and β_{21} – linking the respective research constructs (Figure 1). We evaluated the statistical significance of these individual coefficients with the t-test after ensuring acceptable model fit using the absolute criterion, namely: the χ^2 statistic, the goodness of fit index (GFI) and the adjusted goodness of fit index (AGFI). In addition, we used a relative criterion of model fit, namely: the difference in the χ^2 statistic between the theoretical model and an alternative model (Anderson and Gerbing, 1988).

The need for a relative criterion is necessary since an acceptable χ^2 statistic *per se* (i.e., absolute criterion) does not rule out a rival hypothesis that a competing model may fit the data equally well. For this purpose, we specified an alternative, constrained model in which all the four indicators relating to both stockholder ownership and takeover defense adoption represent one single construct of corporate governance that affects IT investments. Since these two models are nested, we compared the difference in χ^2 to determine the relative superiority of the specifications.

The testing of an alternatively specified model is conducted to establish our conceptualization that corporate governance is not an omnibus construct that is measured by all four indicators. Although there are other possible governance constructs (e.g., board of directors, reporting structure between the chief information officer and top management), we focus on two key constructs, namely: stock ownership structure and takeover defense adoption. On theoretical grounds, the first construct deals with effects of the equity capital market, while the second construct considers influences from the market for corporate control. These two market forces are fundamentally different in terms of their origins and purposes.⁴

Step 3. Finally, we assessed the intertemporal stability of the results since our data consisted of observations pooled across two periods (1988 and 1989). For this

purpose, we used a two-group specification (Joreskog and Sorbom, 1989) to compare a model where the structural coefficients (γ_{11} , γ_{21} , and β_{21}) are allowed to vary across the two periods with a constrained model where these coefficients are constrained to be equal across the two periods. An insignificant difference in the χ^2 statistics indicate intertemporal stability of results.

RESULTS

Table 1 summarizes the means and standard deviations as well as the matrix of zero-order correlations, while Table 2 provides the parameter estimates for the theoretical model. As Table 2 indicates, the absolute fit of the theoretical model is acceptable with χ^2 (df:9) = 6.43, $p < .70$, GFI=0.987, and AGFI=0.969. The p-values are higher than the cut-off value of 0.05 and the fit indices are better than the threshold value of 0.95 (Bentler and Bonett, 1980). The estimation of the alternative model yielded the following statistics: χ^2 (df:10) = 22.18, $p < .014$, indicating poor fit to the data. More importantly, the theoretical model is superior to the alternative since the difference in χ^2 (df:1) = 15.75, $p < .01$ indicating that the theoretical model is to be preferred using both absolute and relative criteria.

Table 2 indicates that the path coefficient linking stock ownership structure with IT investments, γ_{21} , has a standardized value of -0.511 with a t-value of -3.38 ($p < .01$). This supports the conservatism hypothesis (1b) that this coefficient is negative. Further, the standardized value for the path coefficient linking takeover defense adoption with IT investments, β_{21} , is -0.443 with a t-value of -2.00 ($p < .05$). This supports the managerial entrenchment hypothesis (2a) that stipulates a negative path relationship here. Finally, the coefficient linking stock ownership structure with takeover defense adoption, γ_{11} , has a standardized value of -0.395 with a t-value of -3.13 ($p < .01$); this supports hypothesis 3 that specifies a negative relationship between the two constructs of corporate governance.

TABLE 1
Means, Standard Deviations, and Correlations

Variable	Mean	Std Dev	OWNLAR	OWNINS	UTODEF	BTODEF	ISBUD	ISVAL
OWNLAR	0.1629	0.2191	1.0000					
OWNINS	0.0879	0.1666	0.5287**	1.0000				
UTODEF	5.8750	2.3019	-0.2174**	-0.1306	1.0000			
BTODEF	0.6932	0.8666	-0.0938	0.0099	0.2585**	1.0000		
ISBUD	0.0344	0.0224	-0.0987	-0.1734*	-0.0112	-0.0301	1.0000	
ISVAL	0.0128	0.0098	-0.0858	-0.0442	-0.0778	-0.1184	0.3677**	1.0000

* $p < .05$ (2-tailed);

** $p < .01$ (2-tailed).

TABLE 2
Maximum Likelihood Estimates
for the Parameters of the Theoretical Model

Parameter	ML Estimate	t-value	Completely Standardized Solution
λ_{11}^x	1.000@	NA	0.995
λ_{21}^x	0.611	9.28**	0.608
λ_{11}^y	1.000@	NA	0.553
λ_{21}^y	0.947	4.06**	0.532
λ_{32}^y	1.000@	NA	0.587
λ_{42}^y	1.013	4.72**	0.592
β_{21}	-0.466	-2.00*	-0.443
γ_{11}	-0.301	-3.13**	-0.395
γ_{21}	-0.221	-3.38**	-0.511
ϕ_{11}	0.990	8.55**	1.000
ψ_{11}	0.262	2.50*	0.844
ψ_{22}	0.247	2.48*	0.721
Theoretical Model Fit	$\chi^2_9 = 6.43$	$p < 0.696$	
	GFI = 0.987	AGFI = 0.969	

@ denotes a parameter that has been standardized to unity

* $p < .05$

** $p < .01$

The two-group unconstrained model (with parameters allowed to vary across the two periods) has a χ^2 (df: 18) = 11.26, $p < .88$; while the constrained model (with parameters constrained to be equal across the two periods) has a χ^2 (df: 21) = 11.78, $p < .95$. The difference in the χ^2 statistic with 3 degrees of freedom (corresponding to the stability of the three coefficients) is 0.52, and is not statistically significant. We therefore accept the model that specifies the equality of parameters across the two periods, supporting intertemporal stability of our results.

DISCUSSION

Although IT investments have increased significantly over the last few years, there is a lack of systematic research on their determinants from a corporate governance perspective. IT investments have been conceptualized based on (a) Nolan's (1973) stage model of computing evolution, which is intuitively appealing, but has not emerged as critical discriminator of IT investments (Benbasat, Dexter, Drury, and Goldstein, 1984); or (b) anecdotal studies that suggest that IT expenditures may be affected by firm size and industry (Weill and Olson, 1989). In theorizing the determinants of IT investments from a corporate governance viewpoint, this paper has offered a more systematic set of results.

Our research model received strong empirical support given the overall fit as well as the significance of the three structural relationships. Two major issues deserve discussions here. One, despite the oft-cited role of monitoring from the equity capital market through stock ownership, we found that conservative investment behavior may result if the stakes in the corporation are high (Hypothesis 1(b)). Although high risks should give high expected returns, stockholders that are adversely affected by downside risks may try to avoid uncertainty. Two, our results pertaining to IT investments add to the body of empirical support for the entrenchment hypothesis relating to other types of

investments (Hypothesis 2(a)). When managers are protected from the threat of corporate control by competing management teams, they have a higher degree of discretionary power. This is vested in the mitigation of employment risks through a reduction in risky investments.

The tendency to restrain the investments in IT is also consistent with the growing empirical evidence that IT capital is negatively related to business performance (Strassmann, 1990), underlying what has been labelled the 'productivity paradox' (Brooke, 1991; Brynjolfsson, 1992). Given the uncertain effects of IT investments and the accompanying possibility of negligible firm level impacts, managers may be reluctant to allocate scarce corporate resources into the IT arena. Indeed this relates to the notion of causal ambiguity (Lippman and Rumelt, 1982), where the uncertain transformation between inputs and outputs may induce conservative investment behavior.

More generally, our results are in line with an established view that individual decision makers tend to be risk averse (Arrow, 1971), and business managers are no exception here (Cyert and March, 1963). The underinvestment phenomenon is also consistent with the argument that risk propensities are dependent on contextual factors (March and Shapira, 1987). The context in our case is a combination of the personal stake in the uncertain performance of the firm as well as the institutional immunity from the threat of the market for corporate control. Such a view indeed has its roots from many seminal studies in psychology (e.g., Kogan and Wallach, 1967).

CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

Our study has contributed to a better understanding of the underlying governance context that affects managers in making IT investment decisions. In particular, we received significant results within a parsimonious model that points

to the possibility of stockholder conservatism and managerial entrenchment. While these findings *per se* are new for IS research, we offer some avenues for extending our line of inquiry.

First, it might be useful to analyze a more comprehensive model of IT investments using a broader range of corporate governance mechanisms that could include top management compensation design, institutional stock ownership, and structure of board of directors. Further, it might be fruitful to examine the role of behavioral factors such as power, prestige, job flexibility, and personality traits that could influence managerial choices in IT investments. Our study is limited by the lack of data pertaining to these constructs, but we enthusiastically call for future researchers to pursue such extensions.

Second, it might be worthwhile to consider the potential role of factors such as firm strategies as well as product-market competition in explaining the level of IT investments. Since our specific model deals only with a corporate level of analysis, some of these potential variables could not be introduced. However, we believe a good starting point might be to emulate the empirical study of Mahmood and Soon (1991) that develops a comprehensive set of measures, while building an emphasis on identifying the determinants of IT investments. In addition, as researchers develop more focused studies within specific industries (Markus and Soh, 1993; Weill, 1992), it may be useful to interrelate corporate governance factors with these more traditional determinants of strategic investments in a particular industry.

Third, it would be useful to decompose the IT investments into those that are infrastructure-specific investments (i.e., required for maintenance of ongoing activities such as payroll, accounting, operations and inventory) from those that are strategy-specific investments aimed at developing capabilities for the firm to compete in the marketplace (e.g., differentiated customer service and electronic linkages to suppliers). Indeed, Weill and Olson (1989) had articulated a distinction of

IT investments into transactional, strategic, and informational. In extension of our study, it may well be that the agent-theoretic arguments would be much stronger when the dependent variable is closely related to competition-oriented investments (which are more risky) than those aimed at maintenance activities.

Finally, it might be instructive to move away from a traditional mindset that there is a unidirectional relationship between corporate governance and IT investments. Loh and Venkatraman (1993) presented conceptual arguments and some preliminary evidence that the agent-theoretic problem in such investments exists in terms of a deviation from some referent levels. This is because under-investments can be due to the risk factor (as in our study here) and over-investments can result from the tendency for managers to engage in perk consumption (i.e., to have excessive computing power that is beyond what is necessary for current and future purposes). Further expanding such a perspective, it might also be informative to test the relationship between IT investments and risk behavior along the predictions of prospect theory where risk aversion becomes risk seeking after a certain threshold level (Kahneman and Tversky, 1979).

APPENDIX

Assessing Potential Effects of Control Variables on IT Investments

Before estimating the theoretical model of determinants of IT investments, we examined the effects of control variables on both measures of IT investments. Specifically, we used the following as independent variables: size (total assets), performance (earnings per share of the previous year), leverage (long-term debt divided by shareholder equity), liquidity (cash and short-term market securities divided by current liabilities), and level of diversification (number of four-digit SIC codes in which the firm has businesses in).⁵ In addition, we used an interaction variable – industry sector (service versus industry) with level of diversification -- as another independent variable.⁶

We regressed each of the dependent variables with all the control variables and a constant. In both sets of results (Table A), the model is not significant and the R^2 is very low. More importantly, none of the coefficients pertaining to the control variables is statistically significant. These findings suggest that our original conceptual model of the determinants of IT investments is not unduly confounded by the control variables. Thus we are confident that our parsimoniously specified model is adequate for inference purposes.

We examined the possibility of multicollinearity amongst the independent variables to rule out that the lack of statistical significance is an underlying econometric artifact of the sample data. Accordingly, we performed several specific tests to assess the presence of multicollinearity, if any. First, we conducted the conditioning index test proposed by Belsley, Kuh, and Welsch (1980). Under this test, we formed a standardized matrix (X) of the data, and computed the eigenvalues of the matrix $X'X$. The conditioning index is given by the square root of the ratio of the maximum eigenvalue and the minimum eigenvalue; in our case, this is equal to 1.845, which is less than the suggested problematic threshold value of 30. Second, we did the variance inflation factor test (see Kennedy, 1992). Here, we formed the inverse of the correlation matrix of the standardized data matrix (X). The diagonal elements of this inverted matrix are called the variance inflation factors, which, in our case range from 1.033 to 1.292. These values are less than a cutoff value of 10. Finally, we also examined the zero-order correlation matrix of the original data; none of the correlations are in the problematic range of above 0.8 to 0.9 (Gujarati, 1978). Overall, these results confirm that multicollinearity is not a confounding problem in our regression analyses.

TABLE A
Regressions of Control Variables on IT Investments

Independent Variable	Dependent Variable			
	IS Budget		IS Value	
	standardized coefficient	t-value	standardized coefficient	t-value
Size	0.0309	0.348	-0.1269	-1.412
Performance	0.0214	0.242	0.0121	0.135
Leverage	0.0381	0.481	0.0335	0.418
Liquidity	-0.1383	-1.560	-0.1302	-1.450
Diversification	-0.0787	-0.988	-0.0207	-0.256
Industry*Diversification	0.1287	1.489	0.0619	0.707
F-Statistic		1.387		0.681
R ²		0.050		0.025
N		164		164

NOTES

¹The following were classified as unilateral takeover defenses: antigreenmail provision, blank check preferred stock, classified board, compensation plan with change in control provision, consider nonfinancial effects of merger, cumulative voting, cumulative voting if there is a substantial shareholder, director indemnification, director indemnification contract, dual class capitalization, employment contracts, fair price requirement, golden parachute, limited action by special meeting, limited director liability, pension parachute, poison pill, silver parachute, supermajority to approve merger, and unequal voting rights; while the following were classified as bilateral takeover defenses: eliminate cumulative voting, limited ability to amend charter, limited ability to amend bylaws, limited action by written consent, and secret ballot. A complete description (including the underlying rationale and effects) of each takeover defense is found in Rosenbaum (1989).

² For each of the 25 mechanisms, we have carefully examined the institutional details and the intended effects. We have identified 4 specific cases where the mechanism can either inhibit or facilitate a hostile takeover bid. For instance, in cumulative voting, shareholders can apportion their total voting entitlement to one or more directors. The elimination of cumulative voting can deprive minority shareholders of assuring that their favored nominees are elected as directors. In this case, an hostile bidder who do not yet attain a majority holding would find it difficult to increase control of the board. On the other hand, eliminating cumulative voting can assist the hostile bidder: if such voting is allowed, a bidder who had 51% of the equity is still not assured of full control of the board. A detailed examination of the other three bilateral mechanisms would reveal analogous two-way effects.

³Since the dataset comprised a mixture of censored, ordinal, and continuous variables, we applied the polychoric correlation matrix. This was obtained using PRELIS, a preprocessor for LISREL 7, that provides an interface with SPSS (Rel. 4); our use of ML estimate is justified by our sample size of 150.

⁴As a further verification for a conceptual distinction between the two constructs, we performed a confirmatory factor analysis. Our results using a model with two first-order factors showed that the indicators load onto the respective governance constructs significantly, while the correlation between the constructs is insignificant. Specifically, the t-values for path linking the indicators to each of the constructs are 3.767 and 6.243 respectively (note that one path in each construct is parameterized to one); further, the t-value for the correlation between the constructs is -1.925.

⁵All financial data are obtained from COMPUSTAT files and CD/Corporate. Diversification data are compiled from *Standard & Poor's Register of Corporations, Directors, and Executives*.

⁶The firms in our sample are typically very diversified with a mean number of four-digit SIC codes equal to 7.37 (standard deviation is 7.46). It is thus more meaningful to control for industry sector by an interaction variable with diversification level.

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